THE PERFORMANCE OF TWO LEGUME-SMOOTH BROME MIXTURES COMPARED TO NITROGEN FERTILIZED SMOOTH BROME UNDER GRAZING

by

STEVEN ROY SEARS

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Approved by:

Gerry L. Posler

Major Professor

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INTRODUCTION

Forages with high quality, uniform seasonal distribution of production, and good yielding ability are very desirable for the livestock producer. Grass pastures with improper soil fertility, poor weed control, or improper cutting or grazing management are usually not very productive. Two alternatives available to producers for improving grassland production are the use of nitrogen fertilizer and the addition of legumes.

Application of nitrogen fertilizers on established grasses has become widely used because of increased dry matter production, simplified management, and reduced year to year variability in production. However, recent increases in nitrogen fertilizer costs and occasional shortages in supply have created a renewed interest in forage legumes.

Legumes in mixtures with grasses offer many advantages. Foremost is their ability to fix atmospheric nitrogen into a form available for plant use. Improved pasture yields and quality, and better seasonal distribution of production also often result. Grass-legume mixtures are more difficult to manage than grasses alone, however, and the degree of success in manipulating grass-legume programs varies widely among producers.

This study was designed to compare the forage yield and quality of alfalfa (*Medicago sativa* L.)-smooth brome (*Bromis inermis* L.) and birdsfoot trefoil (*Lotus corniculatus* L.)-smooth brome mixtures to nitrogen fertilized smooth brome. Yield was determined by ewe grazing days, while quality was determined by chemical analyses and animal performance.

REVIEW OF LITERATURE

Yield and quality of forages have been studied using various methods. In the field, the use of grass-legume mixtures, the use of nitrogen (N) fertilizers, proper selection of species and good cutting management have been shown to improve pastures. In the laboratory, crude protein and *in vitro* digestible dry matter determinations have been useful in the evaluation of forage quality.

Forage Yield

Compatible mixtures of grasses and legumes have generally been reported to yield higher than single components grown in a pure stand (Dubbs, 1971; Wagner, 1954). Schmidt and Tenpas (1965) reported that application of 125 to 175 pounds of elemental nitrogen to pure grass stands resulted in dry matter yields equalling those from good legume-grass mixtures. In an irrigated study in North Dakota, alfalfa-brome mixtures grown under low moisture levels had a yield similar to brome with 40 pounds of N/acre. At medium and high moisture levels, the mixtures yielded as much as brome with 160 pounds of N when cut as hay and as much as brome with 120 pounds of N when grazed (Lorenz et al, 1961). Birdsfoot trefoil-grass mixtures also have been compared to the yields of fertilized grass. In a Iowa study, Kentucky bluegrass (*Poa pratensis* L.) pastures renovated with birdsfoot trefoil yielded more than the bluegrass with 67 kg N/ha (Wedin et al., 1967).

Mixtures also have an advantage in the seasonal distribution of forage production. Wagner (1954) in a Maryland study, reported mixtures were superior in distribution of forage yield through the season and contained fewer weeds than pure stands. In Wisconsin, alfalfa-grass mixtures were

more productive and had a more uniform seasonal distribution of dry matter than the grasses grown alone (Hamilton et al., 1969; Jordan and Wedin, 1961). Birdsfoot trefoil was also found to extend the grazing season through mid-summer when the grass was relatively unproductive in a Ohio study (Van Keuren et al., 1969). Brome, whether in pure stands or mixtures, did not produce well in late summer in Minnesota (Jordan and Wedin, 1961). This is usually a response to available moisture. Schmidt and Tenpas (1965) stated that uniform distribution of seasonal moisture appears to be a more critical production factor for grass fertilized with nitrogen than when grown with legumes.

Species Selection

Selection of well adapted forages for a pasture system is one of the main factors influencing yield and quality. Smooth brome is one of the most common cool-season perennial grasses in eastern Kansas. Brome is a long lived perennial, sod-forming grass and seems to be the most generally suitable cool-season forage crop in eastern Kansas (Barnett et al., 1978; Dicken, 1976). In comparison with other grasses, it performs well under grazing. In a Wisconsin study, when compared to timothy (*Phleum pratense* L.) and orchardgrass (*Dactylis glomerata* L.), brome better withstood intensive grazing pressure and was more persistent in mixtures over a three-year period (Hamilton et al., 1969). For high yields brome can be N-fertilized. The increased production resulting from application of nitrogen fertilizer to brome has been well documented (Barnett et al., 1978; Dicken, 1976; Lechtenberg et al., 1974; Lorenz et al., 1961). Although fertilization does not increase average daily gains, it will increase live-weight gains per hectare by increasing the carrying capacity (Lechtenberg et al., 1974). Drawbacks of N-fertilized brome

include the increased cost and its potential to accumulate unsafe levels of nitrate at high application rates (George et al., 1973).

Alfalfa and birdsfoot trefoil are two legumes commonly used in grass-legume mixtures. Alfalfa has been shown to have high yields, good quality and drouth resistance (Dubbs, 1971; Matches, 1968). It also yields well in mixtures and produces high live-weight gains than N-fertilized grass (Dubbs, 1971; Hamilton et al., 1969). The primary disadvantage of alfalfa is its potential to cause bloat. However, with proper management and the use of Poloxalene, bloat can be avoided (Scott, 1975).

Birdsfoot trefoil is more tolerant to acid, infertile or poorly drained soils than alfalfa. It also has the advantages of being less cyclic in growth habit, drouth tolerant, and is a non-bloating legume (Davis and Bell, 1957; Heath et al., 1973; Wedin et al., 1967). Some problems of persistence have been noted, but birdsfoot trefoil will persist well if allowed to reseed during the year (Dobson et al., 1976; Taylor et al., 1973; Templeton et al., 1967). Birdsfoot trefoil has been reported to be more difficult to establish, slower to recover after grazing, and lower yielding than alfalfa (Davis and Bell, 1957; Marten and Jordan, 1979). It also may delay conception in ewes if grazed during the breeding season (Engle et al., 1957).

Cutting Management

Cutting or grazing management is also important in maintaining high yielding and good quality forages. Any cutting management system that maintains the legume for the longest period of time in grass-legume mixtures gives the greatest return in forage yields and nutrients (Fuellerman et al., 1948). Many studies have been done on the responses to height and frequency of cutting of alfalfa and birdsfoot trefoi.

Managing alfalfa is often difficult because its yield and quality are negatively correlated. The cutting stage must be a compromise between these two parameters. Winch et al., (1970) statedthat harvesting of alfalfa at the medium-bud stage provided highest dry matter yield in conjunction with high crude protein levels, as well as providing persistence of the species. This is in disagreement with the results of Smith (1970) and Gasser and Lachance (1969). Smith reported alfalfa cut at 5-10% flowering stage will result in maximum production, while Gasser and Lachance stated early to late bloom stage provided the most forage per acre and best maintained stand in high productivity. Consistently cutting at pre-bud or bud stage damages stands and results in lower dry matter yield because the plant is unable to store adequate carbohydrates in the root system (Gasser and Lachance, 1969). However, at the bloom stage, stubble height is not important for the regrowth potential (Smith and Nelson, 1967; Smith and Soberalske, 1975). Regrowth of the alfalfa will occur from the stem bases when adequate food reserves are available (Nelson and Smith, 1968). The last cut should be made at least 4 weeks before the average date of the first killing frost. Regrowth to a height of 8 to 10 inches has been shown to provide adequate food reserves for maintenance of stand vigor. After the first killing frost, top growth can be harvested with out danger of stand loss (Gasser and Lachance, 1969; Reinhardt et al., 1978).

Storage of carbohydrates and the regrowth pattern of birdsfoot trefoil is quite different than alfalfa, thus requiring a different cutting management. Trefoil is slower to develop, both vegetatively and reproductively, than alfalfa. Only slight changes in stored carbohydrates occur during the year, regardless of cutting frequency.

Nelson and Smith, (1968) concluded that birdsfoot trefoil accumulated lower carbohydrate reserves in the roots than alfalfa because most of the photosynthate was used for the continued production of top growth by active upper axillary branching. That species difference in carbohydrate accumulation explains in part why height of cutting is more important to the persistence of trefoil than to alfalfa (Dobson et al., 1976; Nelson and Smith, 1968; Smith and Soberalske, 1975).

Grazing management must be designed with the growth pattern of the forage in mind. Alfalfa, with a more cyclic pattern of growth is best suited to heavy rotational grazing. Grazing alfalfa-brome rotationally over three paddocks resulted in significantly greater lamb production in a study by Jordan and Wedin (1961). Smith and Nelson (1967) found both alfalfa and birdsfoot trefoil yields peaked at a three cut system, with the last cut after the first killing frost. However from the standpoint of stand longevity, they concluded that birdsfoot trefoil can be harvested frequently, but not closely; whereas alfalfa may be harvested more closely, but not frequently.

Some differences in the literature regarding management of alfalfa and birdsfoot trefoil can be attributed to varietal differences. Gasser and Lachance (1969) found significant differences in dry matter yields between DuPuits and Vernal alfalfas; and between Viking and Empire birdsfoot trefoils. Trefoils that are basally prostrate (Empire, Dawn) can persist better than alfalfa when more frequently grazed than the upright variety (Viking) (Smith and Nelson, 1967; Van Keuren et al., 1969). The protein and other quality aspects of both alfalfa and trefoil inversely follow the yield trends. If intervals between cuts are shorter, crude protein and general forage quality will be higher (Gasser and Lachance,

1969).

Cutting schedules for nitrogen fertilized brome based on morphological development are important in attaining high seasonal yields of dry matter, quality and persistence (Winch et al., 1970). When a four-cut schedule was used in a Canadian study, in a pure stand of brome, the heads emerged stage was found to be optimum. However, there was apparently better persistence and greater production in the following year when the pre-elongation cutting schedule was utilized. Brome had very poor stands and low yields when three cuts were obtained annually irrespective of stubble heights. The best stands and highest yields of brome were obtained with two cuts annually and there was no effect of stubble height on a two-cut system. Lack of persistence of brome with the three-cut system was attributed to cutting the grass at the early stage of stem elongation of the first crop in June. Plants cut between early stem elongation and infloresence emergence are weakened (Smith et al., 1973). A taller stubble height of bromegrass appears to be more important when grown in a mixture than in pure stands (Nielson et al., 1969). In a mixture the brome needs the extra leaf area to be able to compete with the legume.

Botanical Composition

Cutting frequency is also very important for keeping the desired botanical composition in grass-legume mixtures. Many factors influence botanical composition, but harvesting management is the best tool for maintaining the stands. Delaying time of herbage defoliation in the spring was found to be conducive to the development of a sward higher in grass content. Early grazing encouraged weediness (Templeton et al., 1967). Smooth brome increased in percent as the first harvest was progressively delayed in mixtures with alfalfa (Hamilton et al., 1969).

Grasses are also encouraged when frequently grazed. Grazing increased the percent brome in a alfalfa-brome sward compared to hay harvesting (Lorenz et al., 1969).

Moisture levels also influence the botanical composition. The percent alfalfa was increased at medium and high moisture levels, but decreased at low moisture levels when grown with brome (Lorenz, 1961). Dry weather and continuous grazing were found to decrease the percent birdsfoot trefoil when grown in a mixture (Davis and Bell, 1957; Van Keuren et al., 1969). Calder (1970) found continuous grazing decreased legume survival in a study with sheep and cattle when compared to a rotational system. Under intensive rotational grazing, Hamilton et al., (1969) were unable to retain a satisfactory percentage of grass in their mixtures. Rotational grazing was found to be better for alfalfa maintenance in the stand when grown with brome. Continuous grazing gives alfalfa little opportunity for recovery, and it will be differentially selected because it appears to be more palatable than brome (Fuellerman et al., 1969).

Forage Quality

The term'forage quality' includes both nutritive value of forages and their rate of consumption (Heath et al., 1973). Nutritive value of a forage is characterized by its chemical composition, digestibility, and nature of the digested products. Rate of consumption of a forage is related to the readiness with which a forage is selected and eaten. Consumption is also related to the rate of passage in the digestive tract (Heath et al., 1973). Barnes (1965) stated the nutritive value and rate of intake are two characteristics of the greatest importance in the evaluation of forage crops.

Yield of animal product represents a summation of all quality features of various forages (Barnes, 1965). The best and ultimate forage test is by the animal that eats it Coppock (1976).

Average daily gain was the most important parameter in Marten and Jordan's (1979) grazing trials. Research results are not totally in agreement concerning the value of grass-legume mixtures on average daily gain. No significant difference in rate of gain of lambs was found when comparing a pure stand of brome to an alfalfa-brome mixture in a Minnesota Study (Jordan and Wedin, 1961). Hamilton et al. (1969) also reported no statistical difference when comparing brome to alfalfa-brome in respect to average daily gain. However, Wedin et al. (1967) reported greater average daily gains for yearling steers on pastures renovated with birdsfoot trefoil than for fertilized bluegrass (Pca Pratensis L.). When comparing alfalfa and birdsfoot trefoil quality, Marten and Jordan (1979) reported a 23% increase in lamb average daily gain when they substituted birdsfoot trefoil for alfalfa-grass in one-third of the total seasonal pasture over a three year period.

Crude Protein

Crude protein is one of the most valuable chemical tests which can be determined on forages (Coppock, 1976). The nutritive value of forage grasses is generally considered inferior to legumes, mainly because of the lower content digestible protein. However, the digestible protein content of grasses can be raised through N fertilizer (Clark et al., 1966; Jordan and Wedin, 1961). Chemical analyses showed higher protein percentages for high legume containing swards in an Illinois study and

alfalfa maintained a high percentage of protein throughout the grazing season (Fuellerman et al., 1948). Protein content of alfalfa and birdsfoot trefoil are about equal when averaged over the grazing season (Gasser and Lachance, 1969; Taylor et al., 1973).

Digestible Dry Matter

In vitro dry matter digestibility is another laboratory procedure used to estimate forage quality. *In vitro* methods are procedures that digest feedstuffs by using the microorganisms which are obtained from the rumen of a ungulate herbivore. *In vitro* methods have many advantages over *in vivo* methods. Animal digestion trials are expensive and time-consuming, require large amounts of forage, and only allow one forage to be evaluated at a time. The Tilley-Terry method has been reported to be the best laboratory estimate of *in vivo* digestibility (Coppock, 1976). Correlation coefficients from .88 to .97 have been recorded between conventional digestion trials and the artificial rumen technique (Barnes, 1965; Clark and Mott, 1960; Tilley and Terry, 1963). Factors which may influence the magnitude of this correlation include: length of sample storage period, fineness of grind, and the diet of the donor animal. Careful attention to these and other details are necessary to obtain reliable results using the *in vitro* technique (Barnes, 1965). *In vitro* digestion trials can only be a guide to the potential of a feed. Final evaluation with animals is essential for actual forage quality (Tilley and Terry, 1963).

Rate of Consumption

Voluntary intake is another important aspect of forage quality.

Intake was reported by Crampton (1957) to be the one response, shown by animals to different forage samples, which is related to a practical estimate of the quality of that forage. Voluntary consumption is governed by acceptability, rate of digestion, rate of passage, the amount of forage available and environmental effects on the animal (Barnes, 1965). Consumption is a very important factor in forage management. Marten and Jordan (1979) reported a major short-coming of legume-grass mixtures or all-grass systems is that they do not permit adequate energy intake to meet the needs of high producing ruminants. They advocated use of pure legume stands in a pasture system. Van Soest (1965) presented evidence that grasses with high concentration of cell walls will inhibit the rate of digestion and energy intake by ruminants. The cell wall concentrations of birdsfoot trefoil and alfalfa were not sufficiently high to inhibit intake. Thus, legumes are digested more rapidly and ruminants consume them in greater amounts than they consume grasses. Mixtures with a greater legume percentage will have greater intake, particularly when the grasses are in the more mature stages.

MATERIALS AND METHODS

Field Trials

Two grass-legume mixtures were established at the Kansas State University Sheep Research Unit in August, 1975, for comparison with existing smooth brome (hereafter termed brome) pastures fertilized with nitrogen. 'Kanza' alfalfa and 'Dawn' birdsfoot trefoil were the legumes, and 'Achenbach' brome was the grass used in the mixtures. Prior to establishment, lime and phosphorus fertilizers were applied. The brome pastures received 82 lbs. N/A as ammonium nitrate in annual spring applications.

Each of the three pastures were cross-fenced into two areas of 1.0 acre each. Fences were constructed using two barbed-wires, and two smooth electric wires. The barbed-wires were placed at the top and bottom of the fence. Yield data from 1977 were used to investigate use of within pasture replications for forage comparisons. Correlation for within plots or intraclass correlation provided a negligible effect of the LSD used to compare forages (Snedecor and Cochran, 1967). Consequently, data were statistically analysed as a completely randomized design.

Forage yield was determined by recording the number of animal grazing days, and by clipping with a sickle-bar mower. Animal grazing days was reported to be a good measure of the productive potential of a pasture provided good judgement is used in adjusting stocking rate (Davis and Bell, 1957). Michalk and Herbert (1977), reported that clipping furnishes the experiment or with an objective index of pasture yield which is accurate, sensitive and reliable provided that sampling is adequate.

In the ewe grazing day measurement both lambs and ewes were utilized,

so the weights of the animals were adjusted on the basis of metabolic size (weight$^{.75}$) to an average ewe weight of 160 lb. For example, a ewe with a weight of 183 lb. (49.8 lb. metabolic wt.) pastured one day would require 1.1 ewe grazing days of forage.

The climatic pattern during 1978 allowed three grazing periods. Spring grazing began April 29th and ended June 8th. The summer grazing period was July 8th to August 3rd. The grass-legume mixtures were grazed from September 11th to September 29th, and the N-fertilized brome from October 5 to October 19th during the last grazing period. The alfalfa-brome and nitrogen fertilized brome pastures were mowed to a 4 inch stubble after each grazing period.

Table 1 shows the precipitation received at Manhattan during 1978. Annual precipitation was 6.45 inches less than the thirty year average. June and July each were more than one inch less than the average for those months.

During the spring period, twelve cross-bred lambs were grazed continuously in each of the six pastures. These lambs were used as 'testers' to determine average daily gain (ADG) for forage treatments. Mature ewes were utilized as 'grazers' and their stocking rate was adjusted during the season according to the amount of forage available. The weekly adjustment of stocking rate was made by visual appraisal of the pastures. These ewes were also used in the summer and fall grazing periods.

During the spring grazing period, 'tester' lambs were weighed at the beginning, after 20 days, and at the end of the 40 day period. Before the trial began, all lambs were implanted with Ralgro, drenched

Table 1. Inches of precipitation at Manhattan during 1978.

Month	Precipitation 1978	Normal	Departure From Normal
January	0.38	0.86	- .48
February	1.22	0.92	+ .30
March	1.79	1.85	- .06
April	1.46	3.00	- 1.54
May	5.12	4.35	+ .77
June	4.79	5.84	- 1.05
July	3.14	4.30	- 1.16
August	1.23	3.60	- 2.37
September	4.57	3.96	+ .61
October	0.24	2.72	- 2.48
November	2.90	0.98	+ 1.92
December	0.23	1.06	- .83
Annual	27.07	33.44	- 6.37

with Tramisol, ear tagged and alloted into six groups by weight. Lambs were fasted 18 hours from feed and water before weighing.

All sheep received Poloxalene in molasses blocks to prevent any chance of bloat on alfalfa pastures. All treatments were given access to blocks to avoid any bias due to added energy intake. Three grams or more of Poloxalene daily per 100 pounds body weight may be required for reduction of bloat in sheep (Scott, 1973). The sheep also were filled with dry hay before pasturing on alfalfa, to further decrease chance of bloat. No cases of bloat occured during the study.

During the spring period, sheep were grazed for 12 hours and dry-lotted for 12 hours at night to protect the lambs from coyotes.

Quality Analyses

Forage samples were taken approximately every two weeks throughout the grazing season for laboratory analyses. Three samples were taken from each sward. The forage samples were taken from a cut of a hand clipper in width by 16.0 feet long. Botanical compositon, quality and mower-strip yield were taken at the beginning and the end of each grazing period. Four strips 3 feet wide and 10 feet long were cut in each pasture with a sickle-bar mower. All the cut forage of each strip was weighed for yield and two samples of approximately 200 gm were randomly selected. One sample was used to estimate botanical composition and the other was used for laboratory analyses. Botanical separation samples were frozen, then hand separated and dried when convenient.

All samples were dried in a forced air oven at 55 C. for 72 hours and reweighed to determine dry weight. The samples were ground through a Wiley Mill with a 30 mesh (1 mm) screen. Twenty-five to thirty gm

of sample were kept for crude protein and in vitro digestible dry matter analyses.

Crude Protein

To determine protein content, the 'rapid method for the determination of nitrogen in plant tissue' (Linder and Harley, 1942) was modified and used. Four ml of concentrated H_2SO_4 was added to 0.25 gm of ground tissue in 25 x 200 mm ignition tubes. One ml of hydrogen peroxide was added under an exhaust hood and heated for 20 minutes. Samples were removed and allowed to cool for 5-10 minutes. Another ml of hydrogen peroxide was added and the samples were heated on the hot plate for 15 minutes. That process was repeated until the samples were clear. The samples were then diluted to 50 ml with distilled water, mixed and bottled. To 0.5 ml of this solution, 4.5 ml of distilled water was added and mixed. To this solution 2 ml of Solution A* and 2 ml of Solution B* were added. After 1.5 to 2.0 hours the solution was read on a colorimeter. The colorimeter was set a 660 nm and calibrated with known standards. The percent nitrogen was multiplied by 6.25 for the percent crude protein.

*Reagents

Solution A - In 600 ml of distilled water, 85 gm of sodium salicylate was added. Then 0.3 gm of sodium nitroprusside was added and then the solution was diluted to 1.0 liter.

Solution B - In 900 ml of distilled water, 24.0 gm of sodium hydroxide was added. Then 5.0 gm of sodium dichloroisocyanurate was added and the solution was diluted to 1.0 liter.

Digestible Dry Matter

The Tilley and Terry artificial rumen technique was used to determine digestible dry matter percentage (Tilley and Terry, 1963). The

following modifications were used in the procedure. Four gm of plant material were placed in each digestion tube. Thirty-five ml of the buffer-rumen fluid mixture was added to each tube (10.0 ml rumen fluid* and 25.0 ml buffer solution*). The tube was then sealed with a test tuber stopper with a gas release valve. Tubes were incubated at 39 C. for 48 hours. Tubes were mixed every 2 hours during working hours for the 48-hour incubation period.

After the 48-hour period, 1-2 ml of a saturated sodium carbonate solution was added and the tubes were centrifuged for 12 minutes. Supernatant was discarded and 25 ml pepsin solution was added to each tube and sealed with stoppers with gas release valves. Tubes were incubated at 39 C. for another 48 hours. Tubes were mixed four times daily during this incubation period.

After the second 48-hour incubation period, tubes were centrifuged for six minutes. Again the supernatant was discarded and tubes were dried in an oven at 100 C. for two days. Residue in the tubes was weighed to determine the undigested portion of the sample. Standards and duplicates were run to insure accuracy.

*Reagents

Rumen fluid - Collected the day the run was begun, and strained with cheesecloth. Donor animal was on a hay diet similar to the forages tested.

Buffer Solution -

1)	Sodium bicarbonate	735.0 gm
	Sodium phosphate	277.5 gm
	Sodium chloride	35.3 gm
	Potassium chloride	42.7 gm
	Distilled water	15.0 l

2)	Calcium chloride	4.0 gm
	Distilled water	100.0 ml
3)	Magnesium chloride	6.0 gm
	Distilled water	100.0 ml

The three solutions were combined and the final solution was bubbled with CO_2 and incubated at 39 C. until the rumen fluid could be added.

Rate of Digestion

The *in vitro* digestibility procedure was further modified to determine the rate of digestion for selected spring samples. The 144 samples were digested for various numbers of hours for the two stages of digestion. Treatments included: 8-24, 16-24, 24-24, 48-24, and 60-24 hours in the rumen fluid-buffer stage and hours in the pepsin fluid stage respectively. An 8-24 treatment was digested for eight hours in the rumen fluid-buffer, centrifuged, pepsin fluid added, and then digested for 24 hours longer. The modified 48-hour rumen fluid-buffer and 48-hour pepsin described previously was run as a control and all samples were run in duplicate.

All data were statistically analyzed at the Kansas State University Computing Center. Standard Analysis of Variance procedures were followed and means were separated using Fisher's Least Significant Difference method as they are outlined in Snedecor and Cochran (1967). Regression Analysis and Lack of Fit procedures were used on the rate of digestion data as outlined in Draper and Smith (1966).

RESULTS AND DISCUSSION

Spring Grazing Period

Growing animals are often pastured on spring flush growth period of forages. Forage quality at this time is very important for good animal performance.

Crude Protein

Data for crude protein percentages during the spring grazing period are shown in Table 2. That period was divided into two 20-day intervals for a more detailed analyses. Three sampling dates were included in each interval.

The three forages did not differ significantly during either of the 20-day intervals for crude protein content ($P<.44$, .27). All forages decreased in protein content with increasing maturity. However, protein content was less affected by increasing maturity than the other quality parameters that were evaluated.

Similar protein content of the forages would usually be expected in the spring. Cool-season grasses are at their peak quality during the spring, consequently, the nitrogen fertilized brome had protein content similar to the grass-legume mixtures.

Digestible Dry Matter

In vitro dry matter digestibilities for the spring period are shown in Table 3. N-fertilized brome was more digestible than alfalfa-brome in the first 20-day interval, with birdsfoot trefoil-brome being intermediate ($P<.02$). The forage digestibilities were not significantly different for the last twenty days ($P<.21$). Considering the entire 40-day trial, birdsfoot trefoil-brome and nitrogen fertilized brome were more digestible than alfalfa-brome ($P<.02$). All forages decreased in

Table 2. Percentage of crude protein for three forages during the spring grazing period.

Forage	Day 1-20	Day 21-41	Day 1-41
Alfalfa-Brome	17.87	14.63	16.25
Birdsfoot trefoil-Brome	17.44	16.32	16.88
Brome + Nitrogen	19.01	12.19	15.60
$LSD_{.05}$	NS	NS	NS
$LSD_{.10}$	NS	NS	NS

Table 3. Percentage of *in vitro* digestible dry matter for three forages during the spring grazing period.

Forage	Day 1-20	Day 21-41	Day 1-41
Alfalfa-Brome	71.84	61.84	66.84
Birdsfoot trefoil-Brome	73.60	65.64	69.62
Brome + Nitrogen	75.56	64.62	70.09
$LSD_{.05}$	2.09	NS	2.03
$LSD_{.10}$	1.54	NS	1.50

digestibility as the forages matured.

Nitrogen fertilized brome and birdsfoot trefoil-brome were more digestible in the first 20 days, apparently due to their less mature stage of growth as opposed to alfalfa-brome. In the beginning of the grazing period, alfalfa was in the 10% bloom stage, while N-fertilized brome and the trefoil-brome were still in the early vegetative growth as indicated by their beginning yields (Table 8). Therefore, the alfalfa was at a later stage in maturity and was less digestible.

Dry Matter Content

Dry matter percentages are reported in Table 4. During the spring growth the three forages did not differ significantly ($P<.17$, .49, .33) at any time in percent dry matter. Percent dry matter, as expected, increased with advancing maturity of the forages. The dry matter content of the forages ranged from 22.28% to 37.25% during the spring.

Average Daily Gains

Lamb average daily gains during the first 20-day interval, ranged from 0.56 to 0.64 lbs/hd/day (Table 5). Gains did not differ significantly ($P<.26$) among forages during the first interval. The gains dropped during the second interval. That would be expected with decreasing protein content and digestibilities of the forages. Both legume-grass mixtures had higher gains than the brome grown alone during the second 20-day interval ($P<.01$). However, when compared for the total spring period there were no statistical differences ($P<.28$) for ADG among forages.

Table 4. Percentage of dry matter content for three forages during the spring grazing period.

Forage	Day 1-20	Day 21-41	Day 1-41
Alfalfa-Brome	0.23	0.28	0.26
Birdsfoot trefoil-Brome	0.25	0.28	0.27
Brome + Nitrogen	0.29	0.31	0.30
$LSD_{.05}$	NS	NS	NS
$LSD_{.10}$	NS	NS	NS

Table 5. Lamb average daily gain in pounds for three forages during the spring grazing period.

Forage	Day 1-20	Day 21-41	Day 1-41
Alfalfa-Brome	0.64	0.34	0.49
Birdsfoot trefoil-Brome	0.56	0.35	0.46
Brome + Nitrogen	0.62	0.28	0.45
$LSD_{.05}$	NS	.03	NS
$LSD_{.10}$	NS	.02	NS

Quality-Gain Correlations

Percentages of crude protein and dry matter digistibility were each correlated with lamb average daily gains. Figure 1 shows that average daily gains increased with increasing protein content. Protein values of 18-19% were associated with weight gains of 0.55 to 0.65 pounds per day, and values of 12-14% were associated with gains of 0.25 to 0.35 pounds per day. The correlation coefficient was highly significant ($r = 0.76$).

The correlation of in vitro dry matter digestibility and average daily gain is shown in Figure 2. These two parameters were even more correlated ($r = 0.89$). Digestible dry matter contents of 72-76% were associated with gains of 0.55 to 0.65 pounds per day; and with digestibilities of 62-68%, gains of 0.25 to 0.35 pounds were observed.

Rate of Digestion

The standard in vitro method has been shown to closely estimate forage quality. However, it does not provide information concerning how rapidly the forages are digested. A forage that is digested at a faster rate will benefit the animal more than one that is more slowly digested, if the other quality aspects are equal. With more forage being consumed, and digested, the animal will have a greater energy and nutrient intake that can be used for growth.

Rate of digestion was determined for the three forages and four different dates. Since the date by forage interaction was not significant ($P<.36$), mean differences among forages and among dates were compared. Regression slopes of the data for the four spring sampling dates are shown in Figure 3. The slopes show no differences among dates ($P<.41$) in the rate of digestion with the lines being almost

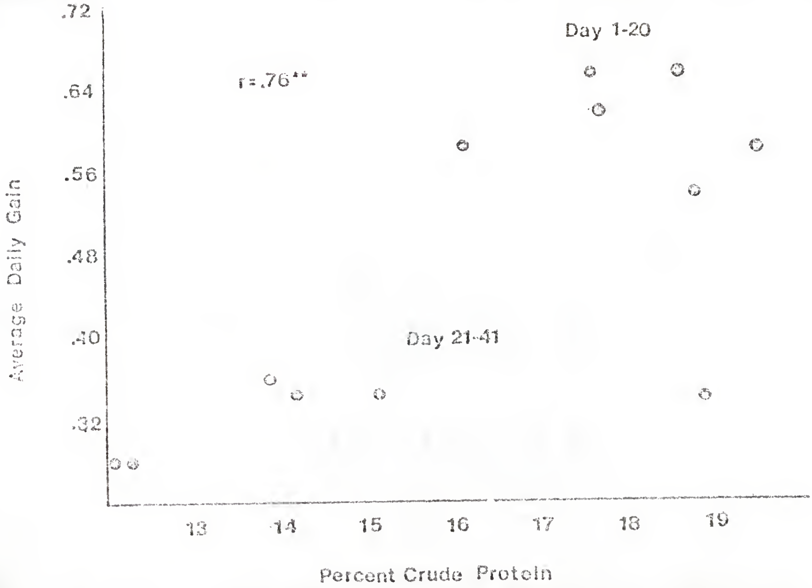

Figure 1. The correlation of the percentage of crude protein and pounds of average daily gain.

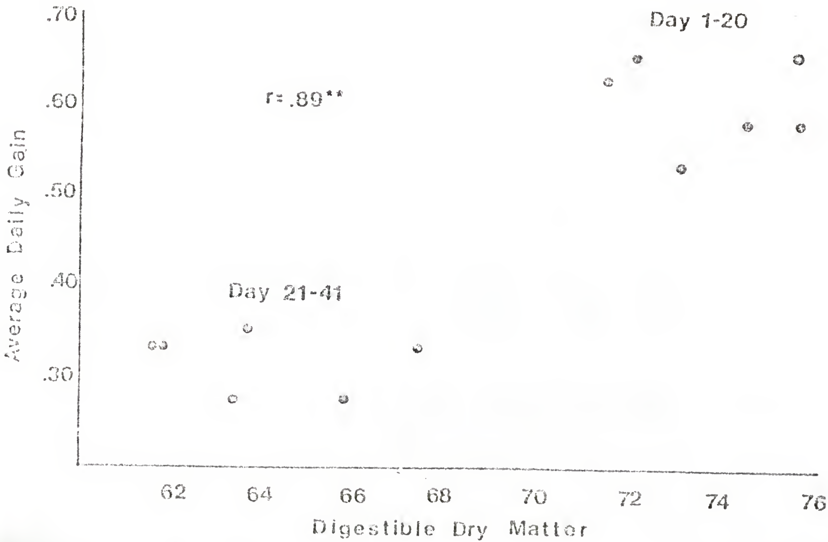

Figure 2. The correlation of the percentage of digestible dry matter and pounds of average daily gain.

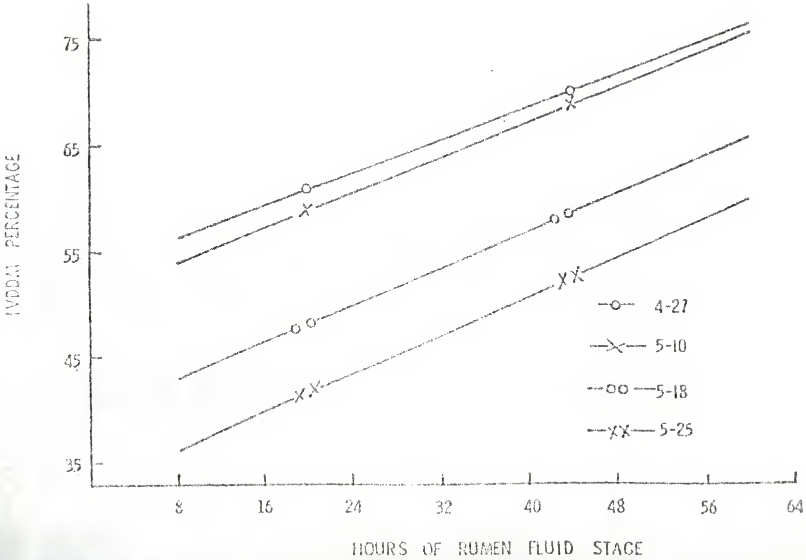

Figure 3. Regression of in vitro digestibilities on the hours of rumen fluid incubation for four sampling dates.

parallel. Forages sampled on April 27 and May 10 were more digestible for all the treatments than those of the last two dates, May 18 and May 25. Digestibility of the forages dropped approximately 10% between May 10 and May 18.

Regression slopes of the rate of digestion of the three forages are shown in Figure 4. Since the slopes differed significantly ($P<.07$), it was concluded that the nitrogen fertilized brome was digested at a slower rate than the two grass-legume mixtures. The magnitude of this difference would likely have been larger if the later stages of maturity of the forages would have been compared. At later stages of maturity the brome would have had a higher cell wall content and would have been slower in the rate of digestion than the legumes (Van Soest, 1965). The number of samples that could be evaluated with the same rumen fluid limited the *in vitro* process to the first four sampling dates.

The difference in the rate of digestion appears to be responsible for higher lamb gains for the mixtures during the last 20-day interval. The nitrogen fertilized brome would be higher in cell wall content and therefore pass through the digestive tract at a slower rate. This would cause the lambs to consume less and consequently gain less.

Total Grazing Season

Botanical Composition

The alfalfa-brome pastures averaged 63.6% legume over the entire grazing season (Table 6). The start of each grazing period always had a higher percent alfalfa than the finish, indicating some animal selectivity for the alfalfa. The birdsfoot trefoil-brome averaged 71.1% legume during the grazing season. Trefoil was slower growing than the

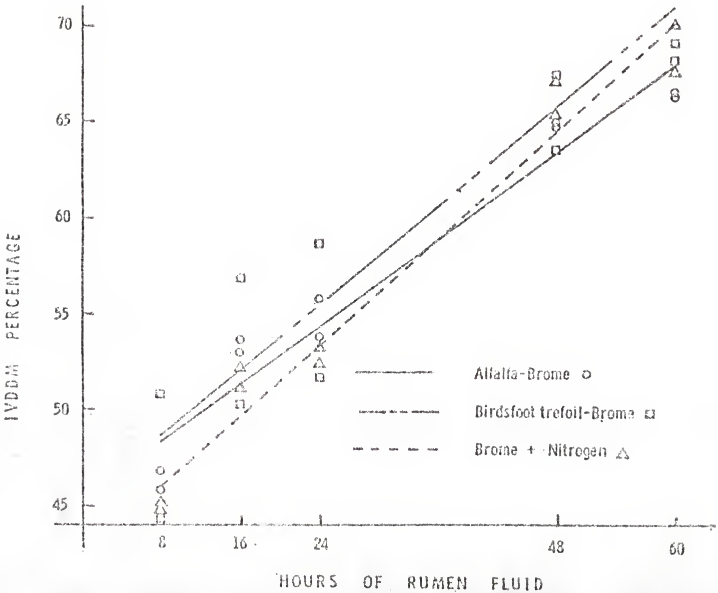

Figure 4. Regression of in vitro digestibilities on the hours of rumen fluid incubation for three forages.

Table 6. Percentage of legume of the two mixtures at the start and finish of the three grazing periods.

	Forage	
Grazing Season	Alfalfa-Brome	Birdsfoot trefoil-Brome
Spring-		
Start	58.0	26.9
Finish	26.9	65.4
Summer-		
Start	74.3	81.8
Finish	48.6	*
Fall		
Start	95.4	93.9
Finish	78.4	87.5
Means	63.6	71.1

*Insufficient forage for sampling.

brome in early spring, but dominated in the mixture during the rest of the season.

Forage Yield

The number of ewe grazing days for the three forages are shown in Table 7. The alfalfa-brome out-yielded both the birdsfoot trefoil-brome and the nitrogen fertilized brome pastures significantly ($P<.01$) during the spring grazing period. The two mixtures did not significantly differ ($P<.05$) in grazing days during the summer grazing period. The summer semi-dormancy of the brome and less than normal precipitation resulted in no available summer grazing for the brome plus nitrogen. That grazing period showed the advantage of the mixtures for better seasonal distribution of forage production. The three forages did not differ statistically ($P<.47$) during the fall grazing period.

Seasonal totals show that alfalfa-brome yielded the greatest number of ewe grazing days, brome plus nitrogen, the least; and the birdsfoot trefoil-brome was intermediate ($P<.01$). Therefore the mixtures not only provided better distribution of forage production, but a greater amount of total yield.

Data for initial and ending yields (Table 8) were determined from mower-strips. Sampling was done one day prior to or on the same day the grazing period was begun, and at the end of each grazing period.

Initial yields of the spring growth showed the alfalfa-brome had produced most of its yield before grazing was begun. Nitrogen fertilized brome had the least initial yield and most of its yield came from the growth during grazing.

Ending yields of the spring period showed the N-fertilizer brome to

Table 7. Number of ewe grazing days for three forages at different grazing periods.

Forage	Grazing Period			
	Spring	Summer	Fall	Total
Alfalfa-Brome	511	174	176	861
Birdsfoot trefoil-Brome	414	142	165	722
Brome + Nitrogen	419	*	137	557
$LSD_{.05}$	20	61	NS	137
$LSD_{.10}$	15	45	NS	101

*Insufficient Forage for Grazing.

Table 8. Tons of dry matter per acre at the start and finish of each grazing period for three forages.

Grazing Period	Forage	Initial Yield	Ending Yield
Spring	Alfalfa-Brome	0.88	0.36
	Birdsfoot trefoil-Brome	0.30	0.25
	Brome + Nitrogen	0.10	0.50
Summer	Alfalfa-Brome	1.00	0.68
	Birdsfoot trefoil-Brome	0.45	.58
Fall	Alfalfa-Brome	0.39	0.26
	Birdsfoot trefoil-Brome	0.73	0.20

to have more forage remaining than the grass-legume mixture. The brome also had a poorer grazing distribution than the mixtures. These facts would indicate the brome was not stocked heavily enough during the spring period.

Yield data for nitrogen fertilized brome was not taken for the summer or fall grazing periods. The summer growth was insufficient for grazing and a frost occured in the late fall before the ending yield could be taken.

Summer yields of the mixtures followed the same trends as the spring period. The more cyclic growth pattern of the alfalfa-brome was again evident during the summer. Most of the production of forage of the alfalfa-brome occured before the grazing started. The birdsfoot trefoil-brome continued production throughout the season because of the indeterminate growth of the trefoil. During the summer, similar amounts of forage were produced before grazing and during grazing.

The mixtures were grazed at an earlier stage of development during the fall grazing period to allow them sufficient regrowth before frost. That earlier grazing decreased all the fall yield values.

Forage Quality

The forages were sampled at fourteen dates during the growing season. Crude protein, *in vitro* digestible dry matter, and dry matter content were the forage quality parameters determined for these sampling dates.

Crude Protein. Crude protein content data are shown in Figure 5. As shown in the Spring data, the first six sampling dates did not differ in crude protein content ($P<.05$). During the major part of the summer

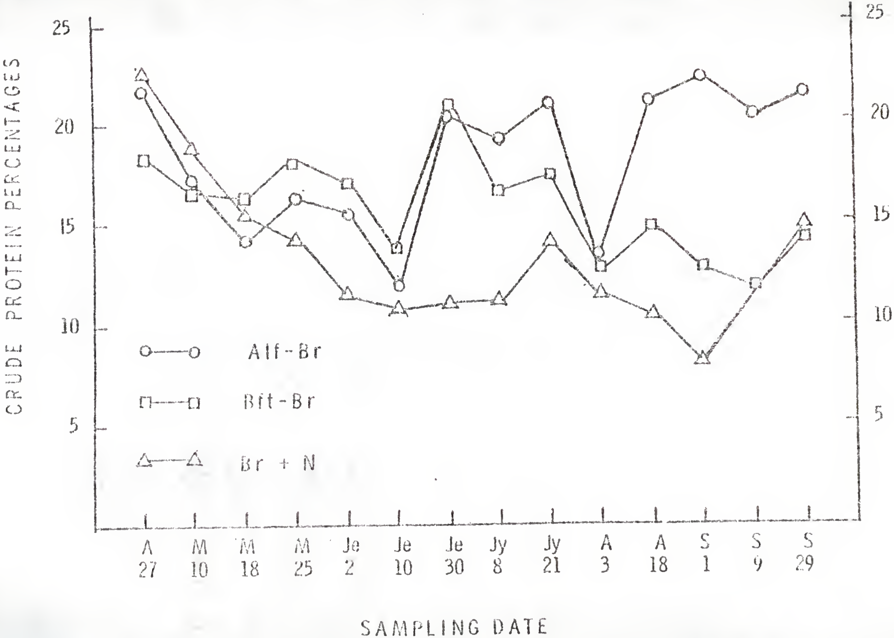

Figure 5. Crude protein content of three forages at fourteen sampling dates during the growing season.

and fall grazing seasons, alfalfa-brome was higher in protein than birdsfoot trefoil-brome and N-fertilized brome ($P<.05$). The brome and the birdsfoot trefoil-brome were not significantly different in protein content ($P<.05$) from the 21st of July to the end of the grazing season.

Sharp decreases of protein content occurred on June 10 and August 3rd. These two dates mark the end of the spring and summer grazing periods. At these dates the brome and alfalfa have flowered and have a high percentage of stem tissue. At this stage of maturity the sheep were selecting leaf tissue and new growth of higher quality. During this time, the samples that are taken contain mostly stem tissue. Birdsfoot trefoil stems were relatively smaller and less lignified so that the sheep did not select the leaves over the stems. However, because of the brome component and the sheep selecting new growth of the trefoil, these pastures also showed a decline in quality at the end of each grazing period.

Digestible Dry Matter. Percent IVDDM is plotted over the fourteen dates in Figure 6. During the season, alfalfa-brome was more digestible than N-fertilized brome at five of the summer and fall sampling dates ($P<.05$).

The lower quality of all forages at the end of each grazing period is again evident. The alfalfa-brome decreased the most rapidly of the three forages at the end of each grazing period. This shows the lower digestibility of the alfalfa-brome stems. It should be reemphasized that the forage samples for quality were composed of all plant material present in a given area. Sheep usually select out the higher quality plant parts when forage is at later stages of maturity.

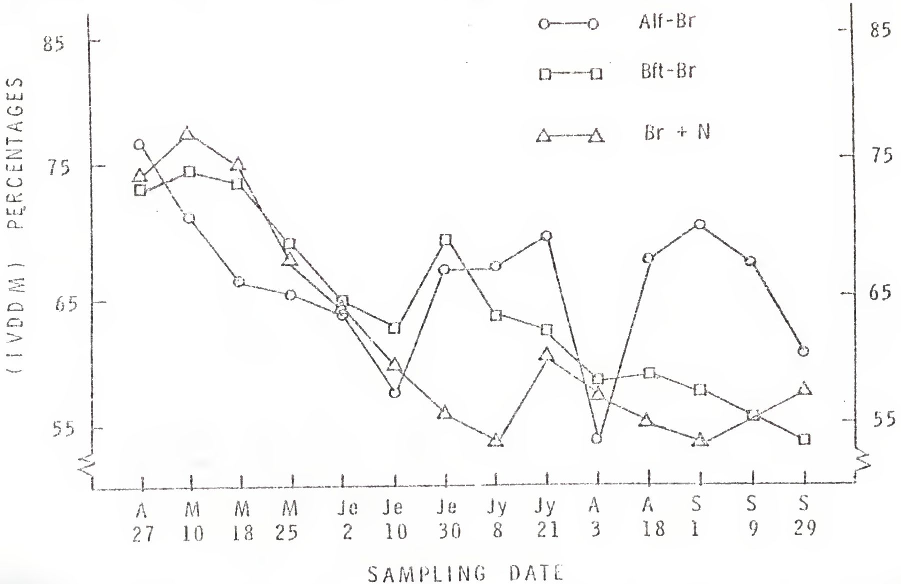

Figure 6. Digestible dry matter content of the three forages at fourteen sampling dates during the growing season.

Birdsfoot trefoil-brome was significantly more digestible than brome plus nitrogen ($P<.05$) only during the June 30 through July 8th period.

Dry Matter Content. Percent dry matter contents of the forages at the fourteen sampling dates are shown in Figure 7. Percent dry matter did not differ among forages during the spring growth. With the exception of the last sampling date, the grass-legume mixtures were consistently lower in dry matter content than the nitrogen fertilized brome for the summer and fall seasons ($P<.05$). The two mixtures had similar dry matter contents during the season with the exception of two September sampling dates when the trefoil contained higher dry matter percent.

The seasonal means of the three quality components are shown in Table 9. When averaged over the season, alfalfa-brome had a higher percent crude protein than N-fertilized brome ($P<.05$). Birdsfoot trefoil-brome was intermediate and not statistically different from either of the other two forages. The seasonal means of IVDDM showed no significant difference among forages. The two grass-legume mixtures were lower in dry matter content ($P<.05$) than the nitrogen fertilized brome.

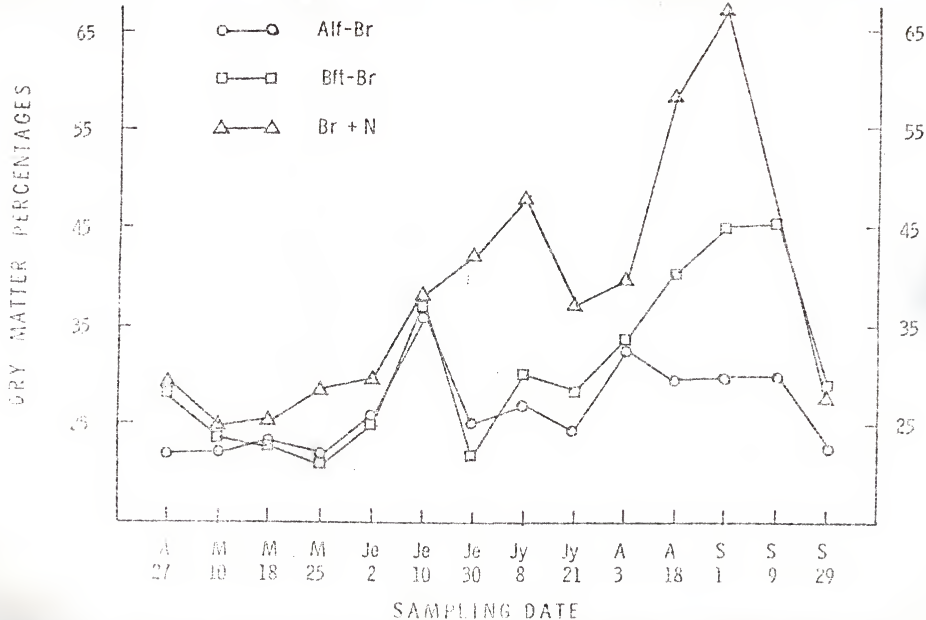

Figure 7. Dry matter content of the three forages at fourteen sampling dates during the growing season.

Table 9. Total grazing season mean percentages of crude protein (C.P.), *in vitro* dry matter digestibility (IVDMD), and dry matter (D.M.) for three forages.

	Component		
Forage	C.P.	IVDMD	D.M.
Alfalfa-Brome	18.25	65.68	27.04
Birdsfoot trefoil-Brome	15.84	64.19	31.42
Brome + Nitrogen	13.49	62.38	37.72
$LSD_{.05}$	2.73	NS	4.93
$LSD_{.10}$	2.02	NS	3.65

SUMMARY

This study was initiated to evaluate the yield and quality of alfalfa-brome and birdsfoot trefoil-brome compared to N-fertilized brome pastures. The results indicate many advantages were obtained by the use of grass-legume mixtures.

1. The mixtures, because of the legume component, were digested at a faster rate than nitrogen fertilized brome.
2. During the spring grazing period, the mixtures produced a slight advantage in lamb average daily gains over N-fertilized brome.
3. Total yield as determined by ewe grazing days was greater for the mixtures than N-fertilized brome.
4. Better distribution of forage production was obtained using the mixtures. The N-fertilized brome provided no grazing during the summer period.
5. The mixtures were generally higher in percent crude protein and percent digestible dry matter during the summer than the N-fertilized brome.

The two grass-legume mixtures also differed during the growing season. The main differences observed are as follows:

1. Alfalfa-brome produced more ewe grazing days in the spring and in total than did birdsfoot trefoil-brome.
2. Alfalfa-brome had a higher percentage of crude protein and digestible dry matter than did birdsfoot trefoil-brome during the major portion of the fall grazing period.

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APPENDIX

Appendix Table 1. Percentage of *in vitro* digestible dry matter of six rumen fluid treatments at four different dates.

	Treatment						
Date	8-24	16-24	24-24	48-24	60-24	48-48	Means
4-27	56.61	60.86	61.59	71.34	72.88	72.05	65.56
5-10	53.05	58.84	60.63	71.67	74.92	73.29	63.82
5-18	40.81	48.81	50.65	62.32	64.34	64.00	53.38
5-25	33.53	43.08	44.44	56.89	58.18	57.18	47.22
$LSD_{.05}$	5.45	5.45	5.45	5.45	5.45	5.45	4.05
$LSD_{.10}$	4.47	4.47	4.47	4.47	4.47	4.47	3.31

Appendix Table 2. Percentage of *in vitro* digestible dry matter of six rumen fluid treatments for three forages.

Forage	8-24	16-24	24-24	48-24	60-24	48-48	Means
Alf-Br	46.29	53.30	54.78	64.94	66.87	66.48	57.15
Bft-Br	47.18	53.62	55.26	65.52	67.54	67.25	58.50
Br + N	44.53	51.76	52.93	66.21	66.78	66.87	56.84
$LSD_{.05}$	NS	NS	NS	NS	NS	NS	NS
$LSD_{.10}$	NS	NS	NS	NS	NS	NS	NS

Appendix Table 3. Percentage of crude protein for three forages at fourteen sampling dates during the grazing season.

Forage	Sampling Date						
	4-27	5-10	5-18	5-25	6-2	6-10	6-30
Alf-Br	21-76	17.31	14.30	16.34	15.55	12.01	20.26
Bft-Br	18.56	17.18	16.57	18.23	17.03	13.69	20.38
Br + N	22.20	19.19	15.64	14.27	11.60	10.70	10.85
$LSD_{.05}$	NS	NS	NS	NS	NS	NS	5.89
	7-8	7-21	8-3	8-18	9-1	9-9	9-29
Alf-Br	19.42	20.89	13.77	21.05	22.28	20.18	21.29
Bft-Br	16.61	17.57	13.43	14.83	12.83	11.75	14.19
Br + N	11.30	14.68	11.50	10.39	7.94	*	14.27
$LSD_{.05}$	5.10	5.89	NS	5.89	5.89	5.10	5.29

* Sample was not taken at this date

Appendix Table 4. Percentage of *in vitro* digestible dry matter for three forages at fourteen sampling dates during the grazing season.

	Sampling date						
Forage	4-27	5-10	5-18	5-25	6-2	6-10	6-30
Alf-Br	76.82	71.90	66.45	64.27	63.00	57.34	66.14
Bft-Br	72.99	74.59	73.22	69.47	65.00	62.59	69.74
Br + N	74.18	77.74	74.95	68.57	64.63	59.69	56.08
$LSD_{.05}$	NS	NS	NS	NS	NS	NS	NS
	7-8	7-21	8-3	8-18	9-1	9-9	9-29
Alf-Br	66.57	68.97	54.03	68.02	70.75	67.68	60.40
Bft-Br	63.60	62.39	58.28	58.93	57.63	55.70	53.72
Br + N	53.68	60.65	57.59	55.05	53.70	*	57.58
$LSD_{.05}$	7.77	NS	NS	8.96	8.96	7.77	NS

*Sample was not taken at this date

Appendix Table 5. Percentage of dry matter for three forages at fourteen sampling dates during the grazing season.

	Sampling Date						
Forage	4-27	5-10	5-18	5-25	6-2	6-10	6-30
Alf-Br	22.68	22.82	23.80	22.42	25.73	35.68	25.02
Bft-Br	27.81	23.68	23.70	22.28	25.47	36.44	22.15
Br + N	28.91	24.43	25.42	28.55	29.90	37.25	42.32
$LSD_{.05}$	NS	NS	NS	NS	NS	NS	11.34
	7-8	7-21	8-3	8-18	9-1	9-9	9-29
Alf-Br	27.13	24.78	32.09	29.67	30.05	30.29	22.89
Bft-Br	30.06	28.55	33.25	40.50	45.17	45.40	29.55
Br + N	48.00	37.42	39.46	58.57	68.00	*	27.58
$LSD_{.05}$	9.82	11.34	NS	11.34	11.34	9.82	NS

*Sample was not taken at this date

Appendix Table 6. Analysis of variance of crude protein content and *in vitro* digestible dry matter for three forages during the spring grazing period.

Interval	Source	DF	Sum of Squares	F Value	Prob.>F
Crude Protein					
Day 1-20					
	Forage	2	2.61963333	1.07	0.4465
	Error	3	3.68030000	--	--
Day 21-41					
	Forage	2	17.20563333	2.02	0.2784
	Error	3	12.786450000	--	--
Day 1-41					
	Forage	2	1.63853333	0.34	0.7363
	Error	3	7.23780000	--	--
IDVDDM					
Day 1-20					
	Forage	2	13.81390000	16.05	0.0250
	Error	3	1.29085000	--	--
Day 21-41					
	Forage	2	15.42870000	2.68	0.2153
	Error	3	8.65010000	--	--
Day 1-41					
	Forage	2	12.34120000	15.18	0.0270
	Error	3	0.00160000	--	--

Appendix Table 7. Analysis of variance of crude protein content and *in vitro* digestible dry matter for three forages during the spring grazing period.

Interval	Source	DF	Sum of Squares	F Value	Prob.>F
Dry Matter					
Day 1-20					
	Forage	2	0.00310000	3.21	0.1799
	Error	3	0.00145000	--	--
Day 21-41					
	Forage	2	0.00120000	0.90	0.4941
	Error	3	0.00200000	--	--
Day 1-41					
	Forage	2	0.00173333	16.3	0.3326
	Error	3	0.00160000	--	--
Average Daily Gains					
Day 1-20					
	Forage	2	0.00693333	2.17	0.2617
	Error	3	0.00480000	--	--
Day 21-41					
	Forage	2	0.00573333	43.00	0.0062
	Error	3	0.00020000	--	--
Day 1-41					
	Forage	2	0.00190000	1.97	0.2848
	Error	3	0.00145000	--	--

Appendix Table 8. Analysis of variance of rate of digestion for four sampling dates and three forages using five *in vitro* techniques.

Source	DF	Sum of Squares	F Value	Prob.>F
Rep	1	269.28048000	--	--
Date	3	6823.74117667	44.70	0.0001
Forage	2	62.34756500	0.61	0.5595
Date*Forage	6	373.19040833	1.22	0.3650
Error (a)	11	559.79542000	--	--
Trt	4	8495.63551167	197.97	0.0001
Date*Trt	12	140.89444833	1.09	0.3862
Forage*Trt	8	94.27044333	1.10	0.3809
Date*Forage*Trt	24	314.96421667	1.22	0.2705
Error (b)	48	514.96670000	--	--

Appendix Table 9. Analysis of variance of the rate of digestion on four sampling dates and three forages regression slope differences.

Source	DF	Sum of Squares	F Value	Prob.>F
CTrt[a]	1	--	--	--
CTrt*Forage	2	59.65311884	2.78	0.070
CTrt*Date	3	31.45185202	0.97	0.411
CTrt*Date*Forage	6	170.18769371	2.64	0.144
Error	48	514.96670000	--	--

CTrt[a] = continuous time scale of treatments.

Appendix Table 10. Regression equations for the rate of digestion for each date and for each forage.

Date	Equation
April 27	.3856 (X) + 53.526 = Y
May 10	.4140 (X) + 50.905 = Y
May 18	.4381 (X) + 39.716 = Y
May 25	.4547 (X) + 33.036 = Y
Forage	Equation
Alfalfa-Brome	.3753 (X) + 45.438 = Y
Birdsfoot trefoil-Brome	.4323 (X) + 45.011 = Y
Brome + Nitrogen	.4616 (X) + 42.438 = Y

Where Y (dependent variable) = percent *in vitro* digestible dry matter and X (independent variable) = the number of hours in the rumen fluid stage.

Appendix Table 11. Analysis of variance of ewe grazing days for three forages.

Grazing Period	Source	DF	Sum of Squares	F Value	Prob.>F
Spring					
	Forage	2	11851.42403333	146.59	0.0010
	Error	3	121.26865000	--	--
Summer					
	Forage	2	34411.30453333	46.76	0.0055
	Error	3	1103.91300000	--	--
Fall					
	Forage	2	1643.38763333	0.96	0.4752
	Error	3	2558.775850000	--	--
Total					
	Forage	2	93332.12110000	25.33	0.0132
	Error	3	5526.40750000	--	--

Appendix Table 12. Analysis of variance of crude protein content, *in vitro* digestible dry matter, and dry matter content for forage and date effects for the growing season.

Source	DF	Sum of Squares	F Value	Prob.>F
		Crude Protein		
Forage	2	984.58841150	14.49	0.0287
Rep(Forage)=E(a)	3	101.91570660	--	--
Date	13	1398.10586566	13.58	0.0001
Forage*Date	25	1466.74282549	7.41	0.0001
Rep*Date(Forage)=E(b)	38	300.85942136	--	--
Sampling Error	193	712.83341667	--	--
		IVDDM		
Forage	2	460.52960272	4.48	0.1256
Rep(Forage)=E(a)	3	154.13129099	--	--
Date	13	9211.23565331	30.98	0.0001
Forage*Date	25	3902.95027935	6.83	0.0001
Rep*Date(Forage)=E(b)	38	869.19241940	--	--
Sampling Error	193	1493.75765834	--	--
		Dry Matter		
Forage	2	5113.66688439	23.12	0.0150
Rep(Forage)=E(a)	3	331.79000990	--	--
Date	13	13323.51661995	32.23	0.0001
Forage*Date	25	6487.77554703	8.16	0.0001
Rep*Date(Forage)=E(b)	38	1208.23370478	--	--
Sampling Error	193	3075.22916667	--	--

THE PERFORMANCE OF TWO LEGUME-SMOOTH BROME MIXTURES COMPARED TO NITROGEN FERTILIZED SMOOTH BROME UNDER GRAZING

by

STEVEN ROY SEARS

B.S., Kansas State University, 1977

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ABSTRACT

During the 1978 growing season, the forage yield and quality of two smooth brome (Bromus inermis L.)-legume mixtures were compared to a long established nitrogen fertilized smooth brome (brome) pasture. The legumes included in the mixtures were alfalfa (Medicago sativa L.) and birdsfoot trefoil (Lotus corniculatus L.). The pure stand of brome was fertilized with 82 lbs. N/A.

Forage yield was determined by animal grazing days while forage quality was determined by digestible dry matter and crude protein content throughout the growing season. During the spring grazing period, lamb average daily gains and in vitro rate of digestion were also determined for the three forages.

Alfalfa-brome produced the highest number of ewe grazing days per acre, birdsfoot trefoil-brome was intermediate, and the nitrogen fertilized brome had the fewest animal grazing days.

The two grass-legume mixtures had a better distribution of forage yield than the nitrogen fertilized brome. The pure stand of brome did not provide sufficient growth for grazing during the summer period.

The brome-legume mixtures also showed a slight advantage in lamb average daily gains over the nitrogen fertilized brome during the spring grazing period. That gain difference was attributed to the slower in vitro rate of digestion of the brome than the legume components of the mixtures.

During the spring grazing period, forages were not statistically different in crude protein or dry matter content. Nitrogen fertilized brome and birdsfoot trefoil-brome were more digestible than alfalfa-

brome during this period.

Alfalfa-brome was higher in crude protein and digestible dry matter than birdsfoot trefoil-brome and nitrogen fertilized brome for the fall grazing period.